QP-5515

DOT MATRIX
LIQUID CRYSTAL DISPLAY
MODULE

USER’S MANUAL

Distributed by:

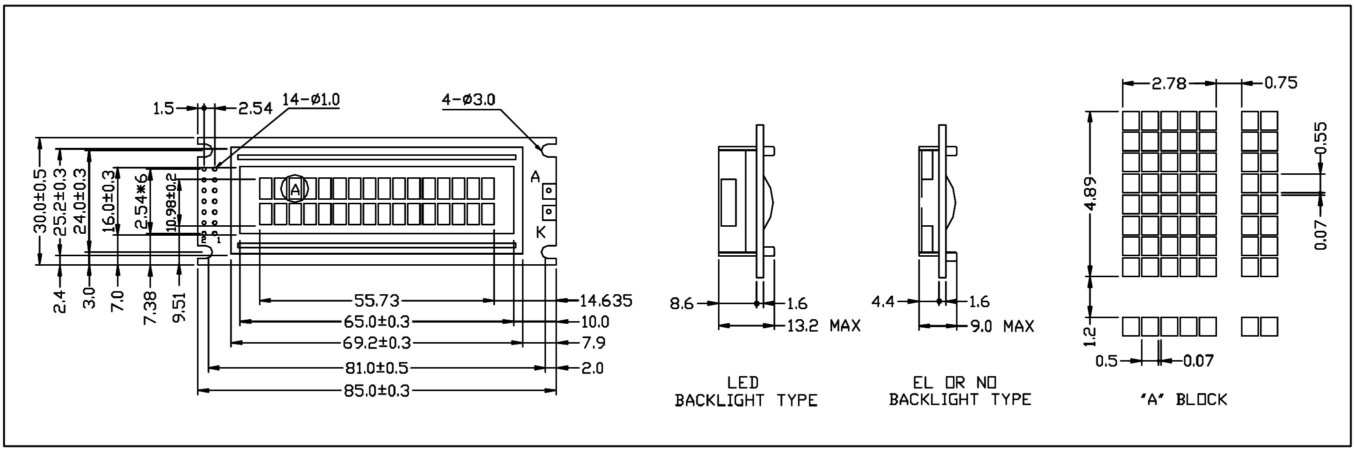
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CONTENTS

1. Mechanical Specification

ITEM	STANDARD VALUE	UNIT
NUMBER OF CHARACTERS	16 CHARACTERS X 2 LINES	--
CHARACTER FORMAT	5 X 8 DOTS	--
MODULE DIMENSION	85.0 (W) X 30.0 (H) X 9.0 (T) 85.0 (W) X 30.0 (H) X 13.2 (T)	mm
VIEWING DISPLAY AREA	65.0 (W) X 16.0 (H)	mm
ACTIVE DISPLAY AREA	56.21 (W) X 10.98 (H)	mm
CHARACTER SIZE	2.78 (W) X 4.89 (H)	mm
CHARACTER PITCH	3.53 (W) X 6.09 (H)	mm
DOT SIZE	0.50 (W) X 0.55 (H)	mm
DOT PITCH	0.57 (W) X 0.62 (H)	mm
DISPLAY	STN , Yellow Green , 1/16 Duty , 6 O'clock	

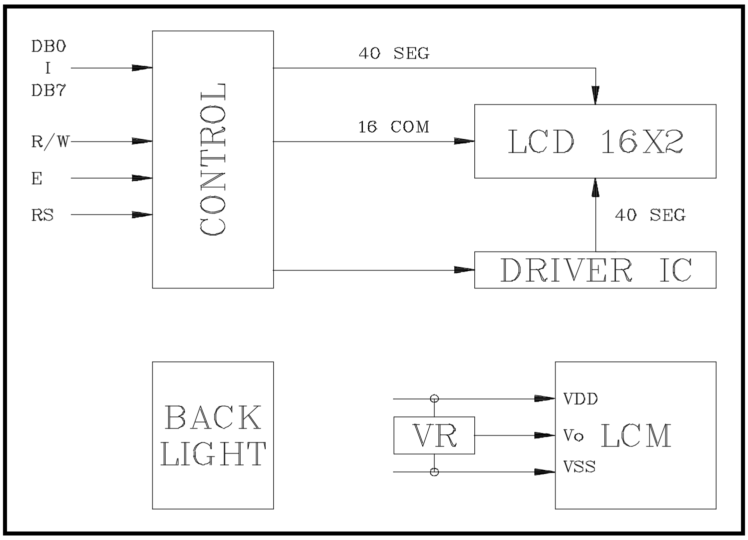
2. Mechanical Diagram



3. Interface Pin Connections

NO	SYMBOL	LEVEL	FUNCTION
1	VDD	--	DC +5V
2	VSS	--	GND (0V)
3	VO	H/L	Contrast Adjust
4	RS	H/L	Register select
5	R/W	H/L	Read/Write
6	E	H,H→L	Enable signal
7	DB0	H/L	Data Bit 0
8	DB1	H/L	Data Bit 1
9	DB2	H/L	Data Bit 2
10	DB3	H/L	Data Bit 3
11	DB4	H/L	Data Bit 4
12	DB5	H/L	Data Bit 5
13	DB6	H/L	Data Bit 6
14	DB7	H/L	Data Bit 7
	A+ (EL1)	--	A (EL Backlight 1)
	K- (EL2)	--	K (EL Backlight 2)

4. Block Diagram



5. Absolute Maximum Ratings

ITEM	SYMBOL	MIN.	TYPE	MAX.	UNIT
OPERATING TEMPERATURE	TOP	0/-20	--	+50/+70	?
STORAGE TEMPERATURE	TST	-10/-30	--	+60/+80	?
INPUT VOLAGE	VI	VSS	--	VDD	V
SUPPLY VOLTAGE FOR LOGIC	VDD-VSS	--	5.0	6.5	V
SUPPLY VOLTAGE FOR LCD	VDD-VO	--	--	6.5	V
STATIC ELECTRICITY	Be sure that you are grounded when handing LCM.				

6. Electrical Characteristics

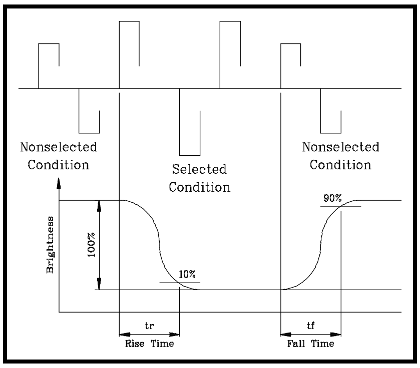
ITEM	SYN	CONDITION	MIN.	TYPE	MAX.	UNIT
SUPPLY VOLTAGE FOR LOGIC	VDD-VSS	--	4.5	5.0	5.5	V
SUPPLY VOLTAGE FOR LCD	VDD-VO	Ta= 0/-20 ? Ta= 25? Ta= +50/+70 ?	-- -- --	4.8/5.0 4.4 4.1/3.9	-- -- --	V V V
INPUT HIGH VOLTAGE	VIH	--	2.2	--	VDD	V
INPUT LOW VOLTAGE	VIL	--	0	--	0.6	V
OUTPUT HIGH VOLTAGE	VOH	--	2.4	--	--	V
OUTPUT LOW VOLTAGE	VOL	--	--	--	0.4	V
SUPPLY CURRENT	IDD	VDD=+5V	--	3.0	4.5	mA

7. Optical Characteristics

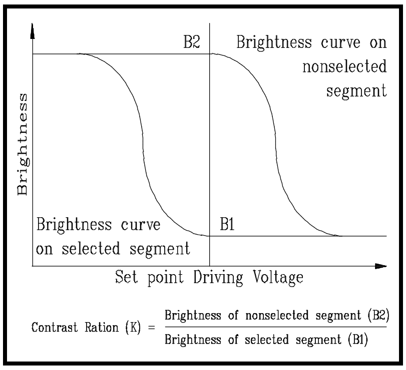
ITEM	SYM	CONDITION	MIN.	TYPE	MAX.	UNIT
VIEW ANGLE (V)	?	CR? 2	-10	--	40	deg.
VIEW ANGLE (H)	f	CR? 2	-30	--	30	deg.
CONTRAST RATIO	CR	--	--	5	--	--
RESPONSE TIME	TON	--	--	180	230	mS
RESPONSE TIME	TOFF	--	--	100	150	mS

8. Optical Definitions

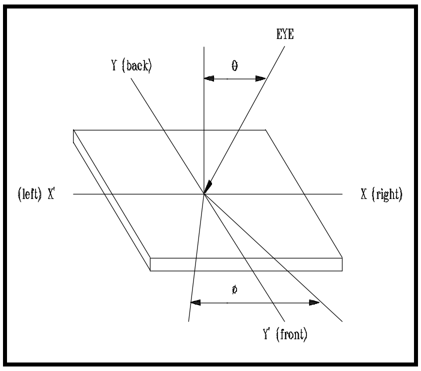
Response Time



Contrast Ration



View Angle

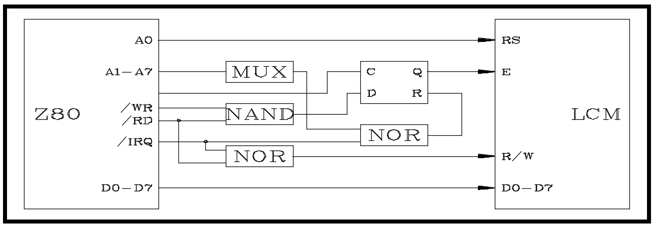


9. Display Address

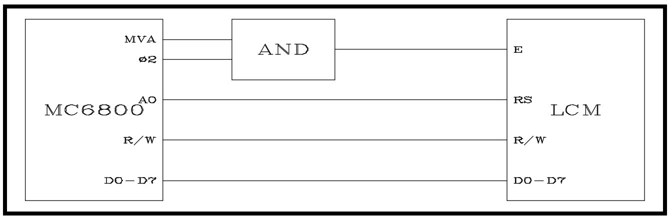
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Line 1	80	81	82	83	84	85	86	87	88	89	8A	8B	8C	8D	8E	8F
Line 2	C0	C1	C2	C3	C4	C5	C6	C7	C8	C9	CA	CB	CC	CD	CE	CF

10. Interface to MPU

10.1 Interface to Z-80 CPU



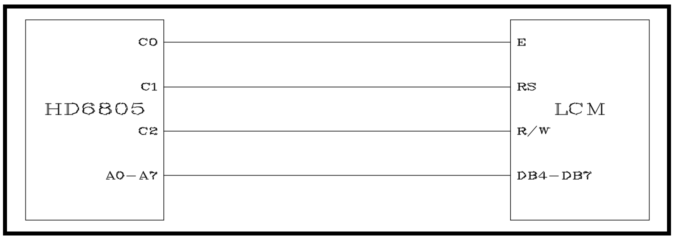
10.2 Interface to MC6800 CPU



10.3 Interface to 4-bit CPU (HMCS43C)



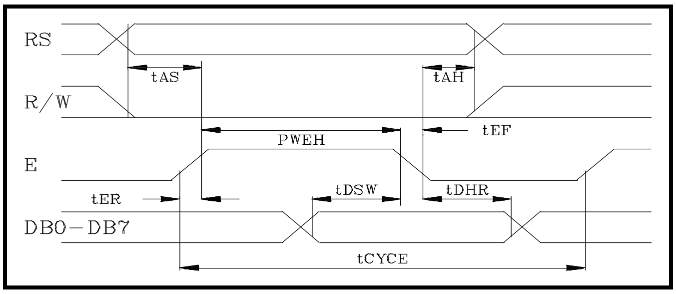
10.4 Interface to HD6805 MP



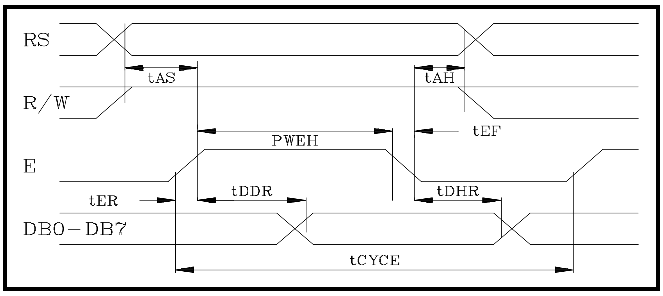
11. Timing Control

11.1 Write and Read Operation

Write Operation

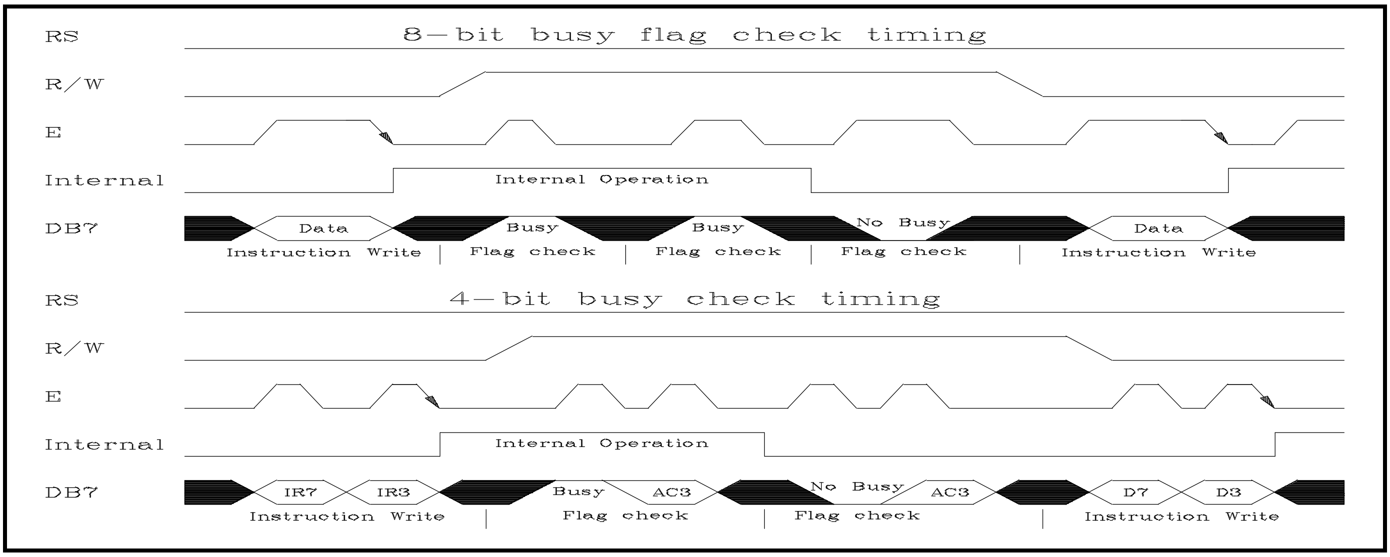


Read Operation



Item	Symbol	Limit (Min.)	Limit (Max.)	Unit
Enable Cycle Time	tCYCE	1000	--	ns
Enable Pules Width (High level)	PWEH	450	--	ns
Enable Rise/Fall Time	tER,tEF	--	25	ns
Address Set-Up Time (RS,R/W,E)	tAS	100	--	ns
Address Hole Time	tAH	10	--	ns
Data Set-Up Time	tDSW	100	--	ns
Data Delay Time	tDDR	--	190	ns
Data Hold Time	tDHR	20	--	ns

11.2 Busy flag check timing

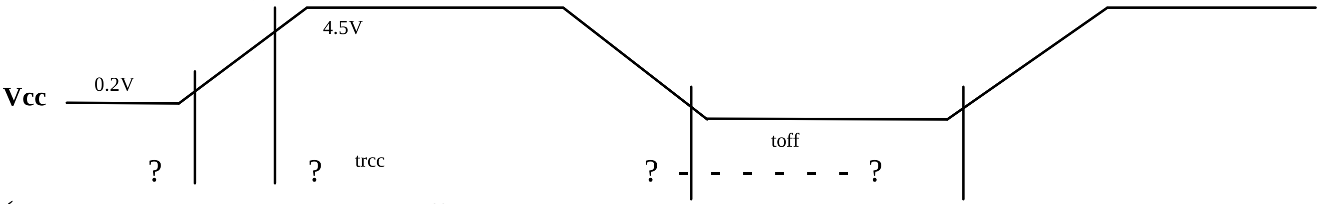


Note : IR7, IR3 : Instruction 7th bit , 3rd bit ; AC3 : Address Counter 3rd bit.

12. Initialization of LCM

The LCM automatically initializes (reset) when power is turned on using the internal reset circuit. If the power supply conditions for correctly operating of the internal reset circuit are not met, initialization by instruction is required. Use the procedure is next page for initialization.

Internal Power Supply reset



(Note 1) 10 ms ? trcc ? 0.1 ms , toff ? 1 ms.

(Note 2) toff stipulates the time of power OFF for momentary power supply dip or when power supply cycles ON and OFF.

Item	Symbol	Test condition	Limit (Min.)	Limit (Max.)	Unit
Power supply rise time	trcc	--	0.1	10	ms
Power supply off time	toff	--	1	--	ms

(a) 8-bit interface

Power ON

?

Wait more than 15ms after V_{DD} rises to $0.9V_{DD}$

?

Function Set

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	0	0	1	1	*	*	*	*

?

Wait more than 4.1 ms

?

Function Set

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	0	0	1	1	*	*	*	*

?

Wait more than 100μ s

?

Function Set

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	0	0	1	1	*	*	*	*

?

Wait more than 100μ s or Busy Flag Check

?

Function Set

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	0	0	1	1	N	F	*	*

?

Display Off

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	0	0	0	0	1	0	0	0

?

Display Clear

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	0	0	0	0	0	0	0	1

?

Entry Mode Set

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	0	0	0	0	0	1	I/D	S

?

Write data to the DD/CG RAM and set the Instruction

(b) 4-bit interface

Power ON

?

Wait more than 15ms after V_{DD} rises to $0.9V_{DD}$

?

Function Set

RS	R/W	DB7	DB6	DB5	DB4
0	0	0	0	1	1

?

Wait more than 4.1 ms

?

Function Set

RS	R/W	DB7	DB6	DB5	DB4
0	0	0	0	1	1

?

Wait more than 100μ s

?

Function Set

RS	R/W	DB7	DB6	DB5	DB4
0	0	0	0	1	1

?

Wait more than 100μ s or Busy Flag Check

?

Function Set

RS	R/W	DB7	DB6	DB5	DB4
0	0	0	0	1	1

?

Function Set

RS	R/W	DB7	DB6	DB5	DB4
0	0	0	0	1	0
0	0	N	F	*	*

?

Display Off

RS	R/W	DB7	DB6	DB5	DB4
0	0	0	0	0	0
0	0	1	0	0	0

?

Display Clear

RS	R/W	DB7	DB6	DB5	DB4
0	0	0	0	0	0
0	0	0	0	0	1

?

Entry Mode Set

RS	R/W	DB7	DB6	DB5	DB4
0	0	0	0	0	0
0	0	0	1	I/D	S

?

Write data to the DD/CG RAM and set the Instruction

13. Instruction Set

FUNCTION	RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	DESCRIPTION	EXECU. TIME* (MAX.)
Clear Display	0	0	0	0	0	0	0	0	0	1	Clears entire display and returns the cursor to home position (address 0).	1.64ms
Return Home	0	0	0	0	0	0	0	0	1	x	Return the cursor to the home position. Also returns the display being shifted to the original position. DD RAM contents remain unchanged.	1.64ms
Entry mode set	0	0	0	0	0	0	0	1	I/D	S	Set cursor move direct and specifies display shift.These operations are performed during data rite/read. For normal operation, set S to zero. I/D=1 : increment ; 0 :decrement ;S=1 : accompanies display shift when data is written, for normal operation, set to zero.	40μ s
Display ON/OFF control	0	0	0	0	0	0	1	D	C	B	Set ON/OFF all display(D),cursor ON/OFF(C), and blink of cursor position character(B). D=1: ON display; 0:OFF display. C=1: ON cursor;0: OFF cursor. B=1: ON blink cursor; 0: OFF blink cursor.	40μ s
Cursor or Display shift	0	0	0	0	0	1	S/C	R/L	x	x	Move the cursor and shift the display without changing DD RAM contents. S/C=1: Display shift; 0:Cursor move. R/L=1: shift to right; 0: shift to left.	40μ s
Function Set	0	0	0	0	1	DL	N	F	x	x	Set the interface data length (DL). Number of display lines (N) and character font (F). DL=1: 8 bits; 0:4 bits. N=1: 2 lines; 0: 1 lines. F=1: 5x10 dots; 0: 5x7 dots.	40μ s
Set CG RAM address	0	0	0	1	ACG						Set CG RAM address. CG RAM data is sent and received after this setting.	40μ s
Set DD RAM address	0	0	1	ADD							Set DD RAM address. DD RAM data is sent and received after this setting	40μ s
Read busy flag & address	0	1	BF	AC							Reads Busy Flag (BF) indicating internal operation is being performed and reads address counter contents. BF=1: internally operating. 0: can accept instruction	1 μ s
Write Data to CG/DDRAM	1	0	WRITE DATA								Write data into DD RAM or CG RAM.	40μ s
Read Data for CG/DDRAM	1	1	READ DATA								Read data from DD RAM or CG RAM	40μ s

14. User Font Patterns (CG RAM Character)

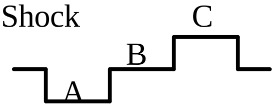
Character Code (DD RAM data)		CG RAM Address			Character Pattern (CG RAM data)		
Hi 7 6 5 4 3 2 1 0 Lo		5 4 3	2 1 0		Hi 7 6 5	4 3 2 1 0	Lo
			0 0 0		x x x	1 1 1 1 0	
			0 0 1		x x x	1 0 0 0 1	
			0 1 0		x x x	1 0 0 0 1	
0 0 0 0 x 0 0 0		0 0 0	0 1 1		x x x	1 1 1 1 0	
			1 0 0		x x x	1 0 1 0 0	
			1 0 1		x x x	1 0 0 1 0	
			1 1 0		x x x	1 0 0 0 1	
			1 1 1		x x x	0 0 0 0 0	
			0 0 0		x x x	1 0 0 0 1	
			0 0 1		x x x	0 1 0 1 0	
			0 1 0		x x x	1 1 1 1 1	
0 0 0 0 x 0 0 1		0 0 1	0 1 1		x x x	0 0 1 0 0	
			1 0 0		x x x	1 1 1 1 1	
			1 0 1		x x x	0 0 1 1 0	
			1 1 0		x x x	0 0 1 0 0	
			1 1 1		x x x	0 0 0 0 0	
----------------		----------------			-------------------------------		
			0 0 0				
			0 0 1				
			0 1 0				
0 0 0 0 x 1 1 1		1 1 1	0 1 1				
			1 0 0				
			1 0 1				
			1 1 0				
			1 1 1				

15. Software Example

15.1 8-bit operation (8 bits 2 lines)

Function	RS	Rw	D7	D6	D5	D4	D3	D2	D1	D0	Display	Description
Power on delay												Initialization. No display appears.
Function set	0	0	0	0	1	1	0	0	x	x		Sets to 8-bit operation and selects 2-line display and 5x7 dots character font. (Note: number of display lines and character fonts cannot be chang after this.)
Display OFF	0	0	0	0	0	0	1	0	0	0		Turn off display.
Display ON	0	0	0	0	0	0	1	1	1	0	_	Turn on display and cursor
Entry Mode Set	0	0	0	0	0	0	0	1	1	0	_	Set mode to increment the address by one and to shift the cursor to the right, at the time of write, to the DD/CG RAM Display is not shifted.
Write data to CG/DD RAM	1	0	0	1	0	1	0	1	0	0	T_	Write “T”. Cursor incremented by one and shift to right.
Write data to CG/DD RAM	1 1 1	0 0 0	0 0 0	1 1 1	0 0 0	0 1 1	0 0 0	1 0 1	0 1 0	1 1 0	TEST_	Write “E” , “S” , and “T”.
Set DD RAM	0	0	1	1	0	0	0	0	0	0	TEST _	Set RAM address so that the cursor is propositioned at the head of the second line.
Write data to CG/DD RAM					* *						TEST CR_	Write “C” , and “R”.
Cursor or display shift	0	0	0	0	0	1	0	0	x	x	TEST CR	Shift only the cursor position to the left.
Write data to CG/DD RAM					* *						TEST WORDS_	Write “WORDS” .
Entry Mode Set	0	0	0	0	0	0	0	1	1	1	TEST WORDS_	Set display mode shift at the time during writing operation.
Write data to CG/DD RAM	1	0	0	1	1	1	1	0	0	0	TEST WORDS x_	Write “ x”. Cursor incremented by one and shift to right. (The display move to left.)
Write data to CG/DD RAM					* *							Write other characters.
Return Home	0	0	0	0	0	0	0	0	1	0	TEST WORDS x.	Return both display and cursor to the original position (Set address to zero).

Reliability Condition

		TN Type		STN Type	
		Normal Temp.	Wide Temp.	Normal Temp.	Wide Temp.
Viewing Angle	Horizontal F	±30°	±30°	±30°	±30°
	Vertical T (?)	10°to 30°	10°to 30°	-10°to 40°	-10°to 40°
Operating Temperature		-10 to 70?	-25 to 80?	0 to 50?	*-20 to 70?
Storage Temperature		-20 to 80?	-35 to 90?	-20 to 70?	*-30 to 80?
High Temperature (Power Off)		240 Hours @70?	240 Hours @90?	240 Hours @65?	240 Hours @75?
Low Temperature (Power Off)		240 Hours @-20?	240 Hours @-35?	240 Hours @-15?	240 Hours @-25?
High Temperature (Power On)		240 Hours @70?	240 Hours @80?	240 Hours @60?	240 Hours @70?
Low Temperature (Power On)		240 Hours @-10?	240 Hours @-25?	240 Hours @-10?	240 Hours @-20?
High Temperature & High Humidity		55? /90%RH 240 Hours	75? /90%RH 240 Hours	45? /90%RH 240 Hours	65? /90%RH 240 Hours
Thermal Shock 5 Cycle 	A	60min@-20?	60min@-35?	60min@-20?	60min@-30?
	B	5min@25?	5min@25?	5min@25?	5min@25?
	C	60min@70?	60min@90?	60min@70?	60min@80?
Expected Lift		50,000 Hours	50,000 Hours	50,000 Hours	50,000 Hours

*Wide temp. version may not available for some products, Please consult our sales engineer or respresentative.

CHARACTER PATTERN CHART (5×7 DOTS +CURSOR)

Higher 4 bit / Lower 4 bit	0000	0010	0011	0100	0101	0110	0111	1010	1011	1100	1101	1110	1111
XXXX0000	CG RAM (1)		0	@	P	`	p		ー	タ	ミ	α	p
XXXX0001	(2)	!	1	A	Q	a	q	。	ア	チ	ム	ä	q
XXXX0010	(3)	"	2	B	R	b	r	「	イ	ツ	メ	β	θ
XXXX0011	(4)	#	3	C	S	c	s	」	ウ	テ	モ	ε	∞
XXXX0100	(5)	$	4	D	T	d	t	、	エ	ト	ヤ	μ	Ω
XXXX0101	(6)	%	5	E	U	e	u	・	オ	ナ	ユ	σ	ü
XXXX0110	(7)	&	6	F	V	f	v	ヲ	カ	ニ	ヨ	ρ	Σ
XXXX0111	(8)	'	7	G	W	g	w	ァ	キ	ヌ	ラ	g	π
XXXX1000	(1)	(	8	H	X	h	x	ィ	ク	ネ	リ	√	x̄
XXXX1001	(2)	)	9	I	Y	i	y	ゥ	ケ	ノ	ル	⁻¹	y
XXXX1010	(3)	*	:	J	Z	j	z	ェ	コ	ハ	レ	j	千
XXXX1011	(4)	+	;	K	[	k	{	ォ	サ	ヒ	ロ	ˣ	万
XXXX1100	(5)	,	<	L	¥	l	|	ャ	シ	フ	ワ	¢	円
XXXX1101	(6)	-	=	M	]	m	}	ュ	ス	ヘ	ン	£	÷
XXXX1110	(7)	.	>	N	^	n	→	ョ	セ	ホ	゛	ñ	
XXXX1111	(8)	/	?	O	_	o	←	ッ	ソ	マ	゜	ö	█

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Document Revision: v1.0
Date of Revision: 28/March/2003